



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re the Application of: Motofumi KASHIWAGI et al.
Application No.10/524,117
Filed: February 10, 2005

Group Art Unit: 2879
Examiner: Christopher M. Raabe

For: LENS ARRAY SHEET

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The Honorable Commissioner of Patents and Trademarks
United States Patent and Trademark Office
Washington, D. C. 20231

DECLARATION UNDER 37 CFR 1.132

Sir:

I, Motofumi KASHIWAGI, declare and state that:

1. In March 1985, I was graduated from SAITAMA University, Faculty of Science and received a degree of Bachelor of Chemical from the same University.

Since 1988, I have been an employee of ZEON Corporation, and till the present time I have been engaged in research of electronic chemical and development of the application.

2. I am familiar with the invention described in the specification of the above-identified application.

3. I carried out the following experiment. Details of my experiment are as follows.

Experiment (comparative)

(Production of Substrate)

After applying a positive type photoresist composition (product name: ZPP1700PG) made by ZEON Corporation by spin-coating on a substrate obtained by forming a film of SiO₂ to 300Å on a silicon, the result was prebaked at 100°C to obtain a resist film of 1.5 μm on the substrate.

The obtained resist film was subjected to exposure of 50 mJ/cm² by an exposure apparatus "PLA501F" made by Canon Inc. via a mask. Then, the width "s" between adjacent

projections or recesses is changed by changing of mask size.

As shown in Fig. 1 and 2, a combination of a pyramid-shaped projection or recess and a flat part is defined “a repeating unit”. The flat part ratio, the proportion of flat part area to repeating unit area, is expressed as indicated below.

$$\text{Flat part ratio [\%]} = (s \times a) / \{a^2 + (s \times a)\} \times 100$$

The width “s” is changed so that the flat ratio is 5-75%.



Fig 1

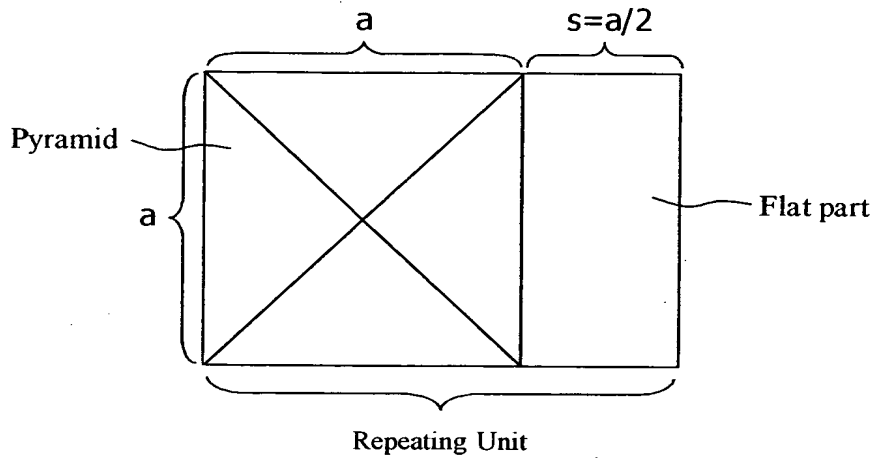
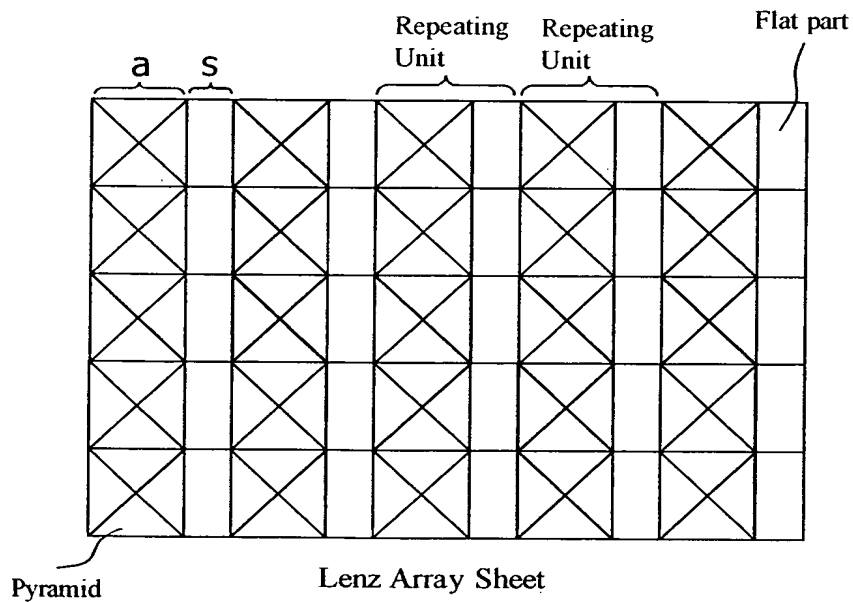


Fig 2



And then, development processing was performed by a 2.38% tetramethyl ammonium hydroxide solution for 60 seconds, and then, rinse processing by ultrapure water was performed for 30 seconds. The substrate was dried by spin processing and prebaking

processing at 120°C was finally performed to obtain a resist pattern on the substrate.

The thus obtained substrate was dipped in a hydrofluoric acid buffer solution (mixture of 3.6% hydrofluoric water and 18% hydrofluoric ammonium water by 1:1 (in volume) at 20°C. It will be the same below.) for five minutes to etch SiO₂, rinsing processing for immersing the etched substrate in pure water for 60 seconds was performed, then, the substrate was dried by spin processing.

The substrate, wherein the oxide silicon film was etched, was immersed in a 30% sodium hydroxide solution for 30 minutes at 80°C, immersed in pure water for 60 seconds, then, dried by blowing a dry air, so that pyramid-shaped concave recesses were formed on the silicon substrate.

To remove an excessive oxide silicon film remaining on the silicon substrate formed with the recesses, the substrate was dipped in a hydrofluoric acid buffer solution for 5 minutes, then, immersed in pure water for 60 seconds, and dried by blowing a dry air, so that a silicon substrate having pyramid-shaped recesses was produced.

(Production of Mold)

After adhering the obtained silicon substrate on a fixture and forming a nickel film of about 500Å by vacuum evaporation on the surface, nickel metal was grown by performing electrolytic soldering in an electrolytic solution containing nickel sulfamate as its main component. The obtained nickel block (metal layer) was peeled from the silicon substrate, so that a mold (convex mold) formed with pyramid-shaped “projections” in a hound’s-tooth check shape was produced.

(Production of Lens Array Sheet)

This mold was set in an injection molding apparatus to obtain a lens array sheet (the outside dimension is 40 mm × 40 mm) having a thickness of about 1 mm by injection molding (resin melt temperature of 285°C, mold temperature of 130°C, and resin filling time of about 0.2 second) using a cycloolefin polymer (ZNR1430R made by ZEON Corporation).

The obtained lens array sheet was formed on its surface with pyramid-shaped “recesses” having a bottom surface of 20 μm × 20 μm, a base angle of side surfaces of approximately 55° and a height of 14 μm in a hound’s-tooth check shape.

(Production of Organic Electroluminescence Element)

ITO having a thickness of 300Å was evaporated on the thus obtained lens array sheet, the result was washed with steam of IPA, set in an organic electroluminescence element

producing apparatus, and subjected to plasma processing at 100W under an atmosphere of oxygen/argon = 50/50 for 5 minutes.

After that, the result was transferred to an organic evaporation chamber, and N,N-di(1-naphthyl)-N,N'-diphenyl-1,1'-diphenyl-1,4-imine (NPD) as a hole transport material and 8-hydroxy quinoline aluminum (Alq3) as an electron transport material were put in two melting pots wound by coil. Then, inside the chamber was depressurized to 10^{-6} Pa and a current of 20A was applied to the coil holding NPD to perform evaporation until the film thickness becomes 400Å, then, evaporation was performed under the same condition until a film thickness of Alq3 becomes 600Å, so that an organic electroluminescence material layer was stacked.

After that, the substrate was moved to a metal evaporation chamber while keeping in the system in a vacuum state, and lithium fluoride loaded on a metal board was heated, so that the lithium fluoride was evaporated to be 5Å on the organic layer. Then, aluminum was loaded on another metal board to evaporate it to be a thickness of 1000Å by the same operation, so that a stacked body, wherein an ITO layer, an organic electroluminescence material layer and a metal electrode layer were stacked, was obtained on the lens array sheet.

The thus obtained stacked body was attached with a stainless sealing tube applied with an ultraviolet ray curing adhesion in a globe box in a dry nitrogen, and an ultraviolet ray was irradiated to adhere the sealing tube, consequently, an organic electroluminescence element was obtained.

(Evaluation of Element)

Measurement of luminance was made on the obtained element by a luminance measurement device (MCPD-3700 made by OTSUKA ELECTRIC CORPORATION) in a state of being placed vertical with respect to the substrate surface. The device is supplied with a voltage of 0.7 V. The result is shown in Fig. 3 and Table 1.

Luminance at flat part ratio of 0% is lower than those at 0-33% (not including 0%) as shown in Fig. 3 and Table 1.

Fig. 3

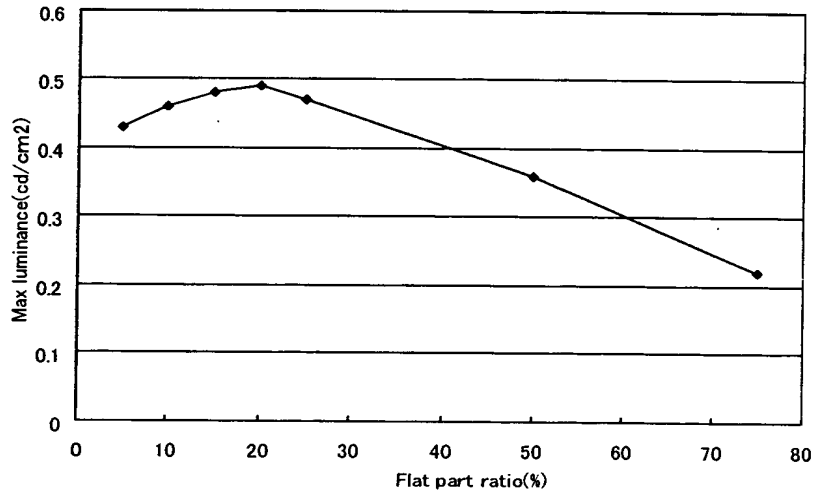


Table 1

Flat part ratio [%]	s/a [%]	Max luminance [cd/cm ²]
0	0	–
5	5	0.43
10	11	0.46
15	18	0.48
20	25	0.49
25	33	0.47
50	100	0.36
75	300	0.22

From the results of the above experiment, and based on my knowledge and experience on Polymer Chemistry, I conclude that:

Luminance at flat part ratio of 0% is expected to be 0.38 cd/cm² by extrapolate. In case that flat part ratio is 0% “s” is 0% of the length “a”.

Luminance at flat part ratio of 33% is 0.43 cd/cm². In case that flat part ratio is 33%, “s” is

50% of the length "a".

When using as a light condensing plate a lens array sheet formed with a plurality of projections or recesses on one surface of a transparent base material film so that the width "s" is more than 0 and not more than 50% of the length "a", luminance of an organic electroluminescence element improves.

The undersigned declares further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

This 22th day of Feburuary 2008

A handwritten signature in cursive script, reading "Motofumi Kashiwagi". The signature is written in dark ink and is positioned above the printed name.

Motofumi KASHIWAGI